VACUUM GRIPPING AND LIFTING SYSTEM: A REVIEW

Varun bhut[1], Sanket Dhameliya[2], Hardik Algotar[3], Jubin Modi[4], Prof. Darshan Bhatt[5]

[1,2,3,4]UG Student , Department of Mechanical Engineering, Indus Institute of Technology and Engineering, Ahmedabad, Gujarat, India
[5]Assistant Professor , Department of Mechanical Engineering, Indus Institute of Technology and Engineering, Ahmedabad, Gujarat, India

---

Abstract:

In any industry objects are lifted and placed at desire places using various techniques like lifting them using chain anchored or wrap that objects in to boxes which is lifted by men. But all these techniques require extra men power and consume lot of time also some objects are very difficult to handle or balance there by requiring great skills to do the job. Vacuum based lifting techniques in this technique suction pad is placed over the object to be lifted. This suction pad is connected with the vacuum pump which creates vacuum inside the pipe. This vacuum is passing through the vacuum hose pipe. During this process suction pad lift the object and the worker besides the machine operate it and can move object to one place to another place. This technique requires no extra human power. This technique consume less time and less human power.

Keywords: Vacuum Transfer, Vacuum Pump, Hose Pipe, Flexible Pipe, Relief Valve, Vacuum Gripper

Introduction:

In various industries lifting and pulling of something happens every second in million count across this globe. Much time is wasted in lifting of material with hoist or cranes etc. If this time is reduced to minimal then whole handling of equipment can be made more efficient. A vacuum lifting apparatus is disclosed for lifting large, heavy objects, wherein the lifting surface of the object deviates somewhat from a planar configuration as in the case of manufacturing deficiencies or where the object is of a flexible nature. A frame has opposed surfaces with a generally peripheral deformable closed-cell resilient gasket partially secured to one surface of the frame along the inner peripheral portions of the gasket in an endless arrangement which defines an open chamber with the frame. A source of reduced atmospheric pressure such as a vacuum pump, selectively communicates with the chamber through a valve, such that positioning the gasket member against the object and drawing a vacuum in the chamber thus creates an atmospheric grip between the frame and the object whereby the object may be lifted by lifting the frame. If the lifting surface is inaccurate, or when the object flexes and assumes a curbed configuration, the partial attachment of the gasket thus permits the gasket to decompress and to flex in accordance with the curvature of the object, thereby maintaining the vacuum within the chamber.

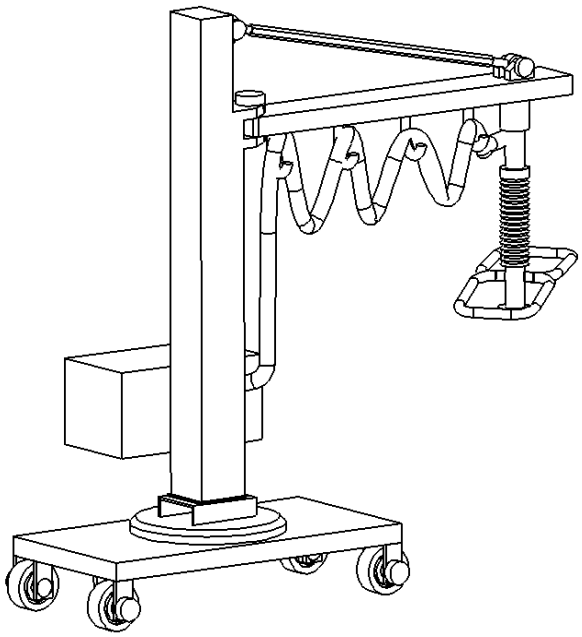

figure 1: vacuum lifter

Working Principle:

The system is worked on principle of vacuum pressure which is created by vacuum pump. There is a flexible pipe which is used to transfer vacuum to the gripper. The vacuum which is created by vacuum pump passing through the flexible pipe to the vacuum gripper, Vacuum gripper get fixed over the material or object to be lift. Once the gripper is over the material, the material to be lift the vacuum pump made on as these objects lift. Again objects is placed where derived by moving arm to desired place. The object is place required position by turn off vacuum pump. By used of wheels we can move object or mechanism are moved to different places.

objectives:

- To reduce time
- To reduce human efforts
- To reduce overall cost
- Less human power required
- To Increase efficiency
- To reduce injury while heavy weight lifting
- Easy to operate

Litreture Review:

(1) **Tudor Catalin Apostolescu et al** has done research in area of vacuum attachment cups for a robot with vertical displacement. This paper reports a part of the results of basic characteristics of vacuum suction cups, representing the adhesion solution for a mobile robot with vertical displacement. The cup behaviour during loading with an external force in normal direction, applied on glass, polished aluminium and textolite, was studied. The force determinations were performed and compared for dry and respectively wet conditions. These results, combined with the ones referring to loading with a lateral force and combined (normal and lateral) forces, are useful for modelling and simulating the robot legs positioning during its sustaining on vertical surfaces.

(2) Fr. Novotny, M. Horak has analyses computer modeling of suction cups used for window cleaning robot and automatic handling of glass sheets. The paper analyze the conventional force process for dimensioning of the gripping element with combined loading by axial and radial forces. Owing to necessity to define deformation and mechanical loading capacity, the computer simulation of the suction cup deformation behaviour was carried out. The verified computer model was applied to describe the course of the suction cup deformation cycle during loading when simple axial, radial and combined stresses were used. FEM outputs were presented by deformations of the suction cup profile at contact point chosen and allow contractual values of deformation safety to be defined. Using modelling, it was found that especially radial loading of suction cups is hazardous. Mainly their combined stress (radial and axial loadings simultaneously) changes the contact surface geometry (the contact profile shape) due to friction and material properties of elastomer and degree of vacuum. Based on the analysis performed, it is necessary to determinate the safety level using deformation behaviour theory as it applies to suction cup loading in practice. In the case dominant radial loading of suction cups, it is necessary the standard safety level value to increase by approximately 60%.

(3)Prof. S.S.Bhansali et al has done the review on wall climbing robot. In Present day the construction and maintenance of smart buildings with architecture of frontages of glass wall attract the service of washing-cleaning and periodically inspection of them. Washing, cleaning and regular inspection of these buildings comes at a very high cost and so these types of smart buildings are increasing so the scope for the wall climbing and cleaning robot is increasing due to its low power consumption and its low manufacturing cost and high operational efficiency. But it's basic aim is to substitute the human operator from hard, Dangerous and high risk's working. In future, range of services by this type of robots are extended when needed.

(4) **A. K. Jaiswal, B. Kumar** has done study on vacuum gripper- an important material handling tool. In this paper, vacuum gripper in industrial robot applications has been discussed exclusively with gripping of different variety of materials/parts comparing with other various types of vacuum grippers. The end effectors must typically be designed for the specific application. By comparison to the human hand, a robot's vacuum gripper is very limited in terms of its mechanical complexity, practical utility and general applications. Vacuum gripper is fruitful for the, objects of very different shape, weight, and fragility can be gripped, and multiple objects can be gripped at once while maintaining their relative distance and orientation. This diversity of Abilities may make the gripper well suited for use in unstructured domains for variable industrial tasks, such as food handling and others. The gripper's airtight construction also provides the potential for use in wet or volatile environments and permits easy cleaning. The prime interest of this paper is to explore the utilities and advantages of vacuum gripper with its applications for different product type manufacturing robot application's industries. So, the industry performance can be increased and which would decrease the cost of the product effectively. Optimal performance of a vacuum gripper is maintained by resetting the gripper to a neutral state between gripping tasks.

Sourav Das, (CAE Analyst) have done research on design and weight optimization of aluminium alloy wheel. In the optimization of wheel rim, the wheel structure and its features are divided into two parts, namely design space and non- design space. The non- design space is the standard design and cannot be modified. The design space is the region for optimizing the weight and shape of the arms. The wheel design space is optimized in order to withstand the existing load of the vehicle with the factor of safety with a least quantity of material and manufacturing cost and losses

(5)Kaustubh V. Wankhade and Dr. N. A. Wankhade have done a review on Design and analysis of transfer trolley for material handling. Researchers have done tremendous work in the area of trolley design with greater reliability, protection and robust design also design was adequate and costs reduced. Speed of trolley can increase by increasing gearbox speed and reducing failures in gearbox. Also did ergonomic study like adjustable handle for minimum pushing efforts for users. Trolleys used in many areas like in hot rolled product handling, grain feeding trolley, in casting industries, shopping malls etc... Much more work is still needed to make use of trolleys in different Areas.

(6)Ayneendra B, Mohd et al have done a study on Trolley Turning and Lifting Mechanism. Nowadays trailers unload goods only in one direction which requires more time. This paper is proposing a trolley turning and lifting mechanism in order to make unloading easier. In

the driver can unload the materials in multi direction without the consumption of extra time with a faster work rate and lesser human involvement. Various tests are performed to analyze efficiency and results and evaluated based on speed and power. It is proved that the proposed mechanism is more effective than unloading mechanism commonly in use nowadays.

(7)Author A.K Jaiswal and B. Kumar ISSN(online) February (2017) Varieties of robotic grippers are developed with high flexibility and multifunctional approaches. In this paper, the study is an innovative approach of a gripper for handling variables size, shape and weight of unpacked food products. Feasibility observations are studied to demonstrate and obtain an overall understanding on the capability and limitations of the vacuum gripper. The main objective of this report is to highlights the importance of vacuum gripper in industrial applications. The end effectors like vacuum gripper are designed for the specific applications. This paper describes a gripping technology and loading approaches. The system comprises of the gripping mechanism itself as well as its supporting environment.

Acknowledgment:

Foremost, I would like to express my sincere gratitude to my guide Prof. Darshan k. Bhatt for the continuous support of my project study and research, for his patience, motivation, enthusiasm, and immense knowledge. His guidance helped me in all the time of research. I could not have imagined having a better advisor and mentor of my project study. I offer my special gratitude to all the faculty members, mechanical engineering department, Indus university for their help and support. I would like to express endless gratitude to "MY PARENTS" who gave me everything they could to enable me to reach the highest possible education level. I only hope that they know how their love, support and patience encouraged me to fulfil their dream.

References:

1. Various Material Handling Systems in Foundry: A Review , Kumbhar P.M., Ballal Y.P and Pawar G.B., ISSN 2394-9333, Sep - Oct 2015

2. HIGH PERFORMANCE ON VACUUM GLASS LIFTER USING SUCKER CUP ARRANGEMENT, Fenil Bhavsar1, Karan Patel2, Ishan Shah3, Prof. Mehul Mehta 4 , e-ISSN (O): 2348-4470

3. Effectiveness of a vacuum lifting system in reducing spinal load during airline baggage handling, Ming-Lun Lua, Jonathan S. Dufourb, Eric B. Westonb, William . Marrasb, March 2018

4. Tudor Catalin Apostolescu, Nicolae Alexandrescu "STUDY ON VACUUM ATTACHMENT CUPS FOR A ROBOT WITH VERTICAL DISPLACEMENT", U.P.B.SCI.BULL., Series D, Vol. 72, Iss. 4, 2010

5. A.K.jaiswal and B.Kumar "VACUUM GRIPPER- An Important Material Handling Tool" International Journal of Science And Technology ISSN(online): 2250-141X, Vol. 7 Issue 1, February 2017

6. Agarwal V. Verma, Agarwal S. Computer-aided evaluation and selection of Optimum Grippers. International Journal Of Production Research 1992; 30(11):2713-2732

7. Schmalz J, Reinhart G. Automated selection and dimensioning of gripper systems. Procedia CIRP 2014; 23:212-216

8. Ayneeendra B, Mohd Salman, Jimmy Thaddeus Ojyok Attari, Marvan E "Trolley turning and Lifting Mechanism" International journal of latest Engineering Research and Application(IJLERA) ISSN:2455-7137 Volume-02, Issue- 5 May-2017, PP-67-74

9. Martimo K., Verbeek J., Karppinen J., Furlan A., Takala, P., Paul F., Kuijer M., Merja jauhiainen M. and Juntura E., 2008. Effect of Training and Lifting Equipment for Preventing back pain in Lifting and Handling Systematic Review. British medical Journal, Vol.336,429-431

10. Kuiper J., Budorf A., Jos h., Monque H., Allaed J. Va and Eira R., 1999 Epidemiologic evidence on manual materials handling as a risk factor for back disorders: A systematic review. International Journal of Industrial Ergonomics, 24,389-404